REMARKS

Claims 1-6 are pending in the application. Claims 1-4 and 6 are rejected. Claim 5 is objected to but would be allowable if placed into independent form. Applicant has amended claims 2 and 5, the latter to place claim 5 into independent form. Nonetheless, Applicants respectfully submit that the invention as defined by the original claims is patentable over the prior art.

Abstract

The abstract is objected to because of a missing word. Applicant has submitted a new Abstract that has the missing word.

Specification

The specification is objected to because of an error in typing a reference number in the text. Applicant has amended the specification in order to overcome the objection. No new matter is added.

Claim Rejections-35 USC 103

Claims 1-3 and 6 are rejected under 35 USC 103 (a) as being unpatentable over Ito (5,407,318) in vie of Kato (5,372,475). This rejection is traversed for at least the following reasons.

Claim 1

The invention as defined by claim 1 is directed to a turbine fuel pump that is characterized by an impeller having a plurality of vanes, each formed into a generally rectangular plate. With reference to Figs. 4 and 5, each vane 18 includes a tip end face 18A that extends circumferentially to define an outer peripheral surface of the impeller, a front face 18B located on a forward side in the rotational direction of the impeller and having a root portion 18 B2 located on a side of the body of the impeller and a tip end portion 18B1 located on a side of an outer periphery of the impeller. The front face 18B is curved such that the tip end portion 18B1 is positioned forwardly in the rotational direction of the impeller relative to the root portion 18B2, as is clear in Fig. 5. A rear face 18C is located on a rearward side in the rotational

direction of the impeller, and a chamfer portion 21 is disposed between the tip end face 18A and the tip end portion 18B1 of the front face 18B.

The advantage of this arrangement, as disclosed at paragraphs [0037] – [0047] with respect to the illustration especially provided in Figs. 4-6, is that the chamfer provides the vane with resistance to cracks or breakage, yet the chamfer does not decrease efficiency. The effect of the chamfer length L on efficiency is illustrated in Fig. 6.

In evaluating the prior art, the definition of the various faces of the vane and the location of the chamfer, as recited in claim 1, must be considered.

Ito

The Examiner asserts that Ito, which was cited by the Applicant in an IDS, discloses a turbine fuel pump substantially as claimed, as outlined in the Office Action at page 3. In particular, the Examiner asserts that Ito discloses a casing 23, motor 25, suction port 35, discharge port 36, impeller 28 and vanes 39, with reference to Fig. 6. The Examiner also asserts that the vanes 39 include a front face 39a, tip end face 39c and rear face 39b, with reference to Fig. 7. Accordingly, the Examiner asserts that Ito teaches the invention substantially as claimed.

The Examiner admits, however, that Ito does not disclose a chamfer portion disposed between the tip end face 39c and tip end portion of the front face 39a (claim 1), with the chamfer portion having a uniform length between the tip end face and the tip end portion of the front face as measured in section perpendicular to the axis of rotation (claim 3), with the chamfer portion being inclined relative to a plane containing the axis of rotation (claim 6). The Examiner looks to Kato for those teachings.

Kato

The Examiner asserts that Kato teaches those features, particularly with respect to Figs. 18-19, and forms the basis for the claimed invention being obviousness. Figs. 18 and 19 illustrate similar structures, but as disclosed at col. 16, line 58-col. 17, line 11, the sloped surfaces 3231a and 3231b in Fig. 18 are symmetrical while the sloped surfaces in Fig. 19 are asymmetrical, the leading surface 3231b being smaller in Fig. 19. Applicant respectfully submits that the Examiner's reliance on Kato is misplaced in several respects.

First, in framing the rejection, the Examiner asserts that the structure may be found in Figs. 18 and 19, with respect to vanes 323, chamfer portion 3231b, tip end face 3230, and an unnumbered tip end portion of a front face. The Examiner asserts that the chamfer is a corner between the tip end face and the tip end portion of the front face, with the chamfer portion having a uniform length between the tip end face and the tip end portion of the front face, with the chamfer portion being inclined relative to a plane containing the axis for purpose of reducing the loss of vortex fuel currents.

Second, the Examiner asserts that it would have been obvious to modify the turbine fuel pump of Ito on the basis of Kato such that a chamfer portion (as defined by the Examiner) is disposed between the tip end face and the tip end portion of the front face to reduce loss of vortex fuel currents.

Third, the Examiner admits that the vanes of Kato are not formed such that the tip end portion is positioned forwardly in the rotational direction of the impeller relative to the root portion. Nonetheless, the Examiner asserts that one skilled in the art would have recognized the teachings of Kato of chamfering a tip portion are applicable to both straight and curved vanes.

In traversing the Examiner's positions, Applicants respectfully point to the structural environment for improving on the prior art impeller vane design, especially one such as found in Ito. The prior art impeller vane design has a front face that is curved. The incorporation of a curve in the vane structure has advantages taught by the present invention and recognized in Ito, namely, higher efficiency. However, the curved face design also leads to significant structural disadvantages, particularly the susceptibility of the pointed tip end of the vane to break or crack. This disadvantage was first noted by Applicants of the present application. It was not noted by Ito or Kato. The solution to this disadvantage is also first provided by the present invention, wherein a chamfer is applied to an otherwise pointed tip end. Significantly, the solution is achieved by the present invention without a sacrifice of efficiency.

It is also important to note that the inventive aspect of Applicants' vane tip design is a combination of structural features and not simply the addition of a single feature, a chamfer. Thus, the Examiner cannot simply point to a chamfer at a vane tip and assert that adding such

chamfers to the structure of Ito is obvious. There is no teaching or suggestion in Kato, either by way of solving a common problem or by achieving a common goal, that would lead to a modification of Ito as asserted by the Examiner. Indeed, the teachings of Kato with respect to Figs. 17-19 focus on providing a chamfer on the rearward side of the vane as a primary goal so that vortex fuel currents are not lost (see col. 16, lines 39-68). The addition of a chamfer on the forward side of the vane as in Figs. 18 and 19 is merely to aid in assembly where the chamfers are of equal size, as described at col. 16, lines 66-68. No apparent advantage is provided by the asymmetrical design of Fig. 19.

Moreover, the structure of Kato teaches away from the present invention. The structure of the vanes in Figs. 18 and 19 is derived by simply shaving away a rectangular corner of the vane without achieving any structural advantage. Indeed, the removal of material would tend to weaken the structure and make it more susceptible to cracking and breakage. Thus, one skilled in the art would tend not to remove material of Ito in the manner taught by Kato, if the goal was greater stability and resistance to cracking and breakage.

Finally, the Examiner justifies the combination of Kato and Ito by asserting that the motivation and purpose is reducing the loss of vortex fuel currents, thus raising fuel efficiency. However, this justification relies on hindsight, as there is no teaching in either reference that the addition of a chamfer to the edge of Ito would raise fuel efficiency or reduce loss of vortex fuel currents. This is based solely on the Examiner's reference to Applicants' teachings and not on any teachings in the reference.

On the foregoing bases, the rejection of claim 1 should be overcome.

Claim 2

The Examiner discounts the limitations of claim 2 by asserting that the cutting limitation is merely a product by process limitation and should be ignored in a structure claim. The claim has been amended to recite that the "chamfer portion is formed as a cut corner." This is a structural rather than process limitation. Otherwise, the patentability of the claim would rely on its dependence from claim 1.

Claim 3

The claim states that the chamfer has a uniform length between the tip end face and tip end portion. The patentability of this claim would rely on its dependence from claim 1.

Claim 6

The claim further defines the chamfer portion as being inclined relative to a plane containing the axis of rotation. The patentability of this claim would rely on its dependence from claim 1.

Claim 4 is rejected under 35 USC 103 (a) as being unpatentable over Ito (5,407,318) in view of Kato (5,372,475) and further in view of Yu (5,762,469). This rejection is traversed for at least the following reasons.

The Examiner asserts that Yu teaches that a chamfered tip may have a dimension as claimed. Importantly, Yu does not remedy the deficiencies of Ito and Kato. There is no teaching that would lead one skilled in the art to modify the tip end of the curved vane of Ito with a chamfer as claimed. The patentability of this claim would depend on that of parent claims 1 and 3.

Summary

Kato (U.S.P. 5,372,475) simply discloses that a chamfer is disposed on a rear face of the vane which is located on a rearward side in the rotational direction of the impeller, so as to raise pump efficiency. The additional chamfer on a front face of the vane which is located on a forward side in the rotational direction of the impeller, is merely provided in order to produce the asymmetrical design, whereby the impeller can be assembled to the pump housing without visual check in the rotational direction. Therefore, Kato does not teach nor suggest any influence on pump efficiency which is caused due to size of the chamfer on the front face of the vane.

Ito (U.S.P. 5,407,318) aims to improve pump efficiency by curving vanes of the impeller so as to incline the rear face of each vane. However, this advantage does not lead to the claimed structure of the present invention.

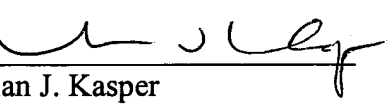
Yu (U.S.P. 5,762,469) aims to improve pump efficiency by chamfering both of opposed end peripheries of a rear face of the vane. However, this does not lead to the present invention.

In particular, the present invention aims to prevent the occurrence of cracks or breakage on the vane of the impeller which has a front face curved such that the tip end portion is positioned forwardly in the rotational direction. Further, the present invention can attain the effect of maintaining good pump efficiency. Therefore, the present invention differs from the above three cited references in view of the purpose and the effect. Accordingly, the subject matter of original claim 1, 3, 4, 6, and that of amended claims 2 and 5, is not anticipated by the combination of the cited references.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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